The Eighth Annual Report on Progress in Implementing the King County *Countywide Planning Policies*

King County Benchmarks 2004 Environment

Highlights

Continuing Increase in Vehicle Travel Affects Environmental Quality

Decreasing the total vehicle miles traveled within the County could provide significant environmental benefits for air quality, climate change, and energy consumption.

This year Indicator 12, *Vehicle Miles Traveled (VMT) Per Year*, reveals that since 1985, we have nearly doubled the number of miles traveled in King County by cars and trucks. After struggling through rush hour on the region's freeways, County residents would probably not find this news surprising. Most of this increase in traffic took place prior to 1995, with the pace of increase slowing in the last few years. VMT includes commercial truck travel as well as personal travel, so it is affected by the economy.

Per Capita VMT Stabilizing

There is some good news in Indicator 12: although we now drive 16.3 billion miles per year, compared to 8.6 billion miles per year in 1985, our per capita miles traveled has leveled off. In 2002 there were 9,174 vehicle miles driven per year per King County resident. This was less than the 9,322 miles driven per capita in 2000, and just slightly more than the 9,154 miles driven per capita in 1995. However, it still represents a 45% increase in per capita vehicle travel since 1985.

While increased traffic does cause an immediate decline in our quality of life, the longer term environmental impact of these numbers is considerable. Air quality is the greatest loser. 54% of air pollution in King County is caused by vehicle emissions, and diesel soot is responsible for 79% of the cancer risk associated with toxic emissions.

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Climate Change and Energy Use Tied to Vehicle Travel

Local data on greenhouse gas emissions have just begun to be collected. Cars, trucks, and buses contribute at least 55% of those emissions in our region. Other regions of the country have more coal-burning facilities which are also a major contributor.

While there are long-term natural climatic changes that have taken place through the earth's history, there is a growing scientific consensus that the climate changes of the last 50 to 100 years are human-induced to a significant extent. The 20th century's 10 warmest years all occurred in the last 15 years of the century. The eight warmest years on record (since accurate record-keeping began in the late 19th century) occurred in the last nine years, i.e. 1995 - 2003. In the Northwest, drier summers and warmer, wetter winters are predicted to lead to a significant decline in snowpack, increased winter run-off and flooding, and more drought in summer.

King County residents have stepped up to the plate and reduced per capita water consumption by 24% since 1985. But with the prospect of a growing population and climate change, progress in water conservation is still needed.

Energy consumption also shows the effect of more driving in a vehicle fleet that is becoming less fuel-efficient. Per capita diesel fuel usage has increased by over 25% since 1996, while per capita gasoline usage has increased by 4.3% in those eight years. Per capita consumption of electricity fell by 5.2%, and per capita natural gas usage fell by 7.4% since 1996, but these gains in energy conservation at home and work have been more than offset by the increase in vehicle fuel consumption. The fuel efficiency of the 2002 model cars and trucks, at 20.2 mpg was at its lowest level since 1980.

Land Use Decisions are Key

Land use choices also play a major role in how we protect our overall environmental quality. Data on lakes, streams, and fish and wildlife habitat show that, by limiting development in the rural areas we are able to maintain those habitats in nearly pristine condition. Streams and sub-basins in the urban area with high levels of impervious surface are in relatively poor condition.

By continuing to concentrate new development in areas close to jobs and public transportation, we can reduce vehicle travel and harmful emissions, cut commute times, and continue to preserve the quality of rural and forest areas, wetlands, and salmon habitat.

Indicator Flags

- There has been a long-term trend in a positive direction, or most recent data shows a marked improvement
- There has been little significant movement in this Indicator, or the trend has been mixed
- There has been a long-term negative trend, or the most recent data shows a significant downturn
- There is insufficient reliable trend data for this Indicator

Outcome: Protect and Enhance Natural Ecosystems

Indicator 9: Land Cover Changes in Urban and Rural Areas Over Time

Countywide Planning Policy Rationale

"The land use pattern for the County shall protect the natural environment by reducing the consumption of land and concentrating development. Urban Growth Areas, Rural Areas, and resource lands shall be designated and the necessary implementing regulations adopted." (FW-6) "All jurisdictions shall protect and enhance the natural ecosystems through comprehensive plans and policies, and develop regulations that reflect natural constraints and protect sensitive features. Land use and development shall be regulated in a manner which respects fish and wildlife habitat in conjunction with natural features and functions, including air and water quality. Natural resources and the built environment shall be managed to protect, improve and sustain environmental quality while minimizing public and private costs." (FW-4)

Background

This examination of land cover change in King County draws on data derived from 1994 and 2001 USGS Landsat Thematic Mapper images. Each pixel of 900 sq. m. or 1,076 sq. yds is given a classification based on the dominant land cover within its area. For instance, a classification of "impervious" or "high intensity urban" will contain at least 75% of impervious (paved or built) surface. Landsat images are registered, intercalibrated, and corrected for atmosphere and topography to ensure accuracy of land cover change assessment. However, given the difficulty of achieving complete comparability between the classification of images taken in different years, there is a margin of error. The measurement of increase in impervious surface and decrease in forest cover shown in Fig. 9.1 are given for King County only, although the map shows areas outside of King County.

Key Trends

Change in Forest Cover

- King County has lost about 2% of its forest cover in the period between 1994 and 2001.
- As the map on the facing page shows, most of the loss (shown in blue) has been in the rural, forested area, but some has also been the result of development just inside the urban growth boundary. Much of the net loss in the rural forest area probably occurred before 1996.
- On the positive side, however, 2001 Landsat data shows 29,400 acres of recently-regenerated forest, equal to 3.4% of the total forested area.

Fig. 9.1

Increase in Impervious Surface and Loss of Forest Cover in King County : 1994 - 2001

	Acres Gained or Lost*	Chg as % of total Cty land area	Estimated Total Acres in this category in 1994	1994 Total as % of Urban Area	Estimated Total in 2001	2001 Total as % of Urban Area
Impervious Surface (gain)	15,524	1.1%	75,576	25.7%	91,100	31.0%
Forest Cover (net loss)	(26,772)	-2.0%	897,772		871,000	

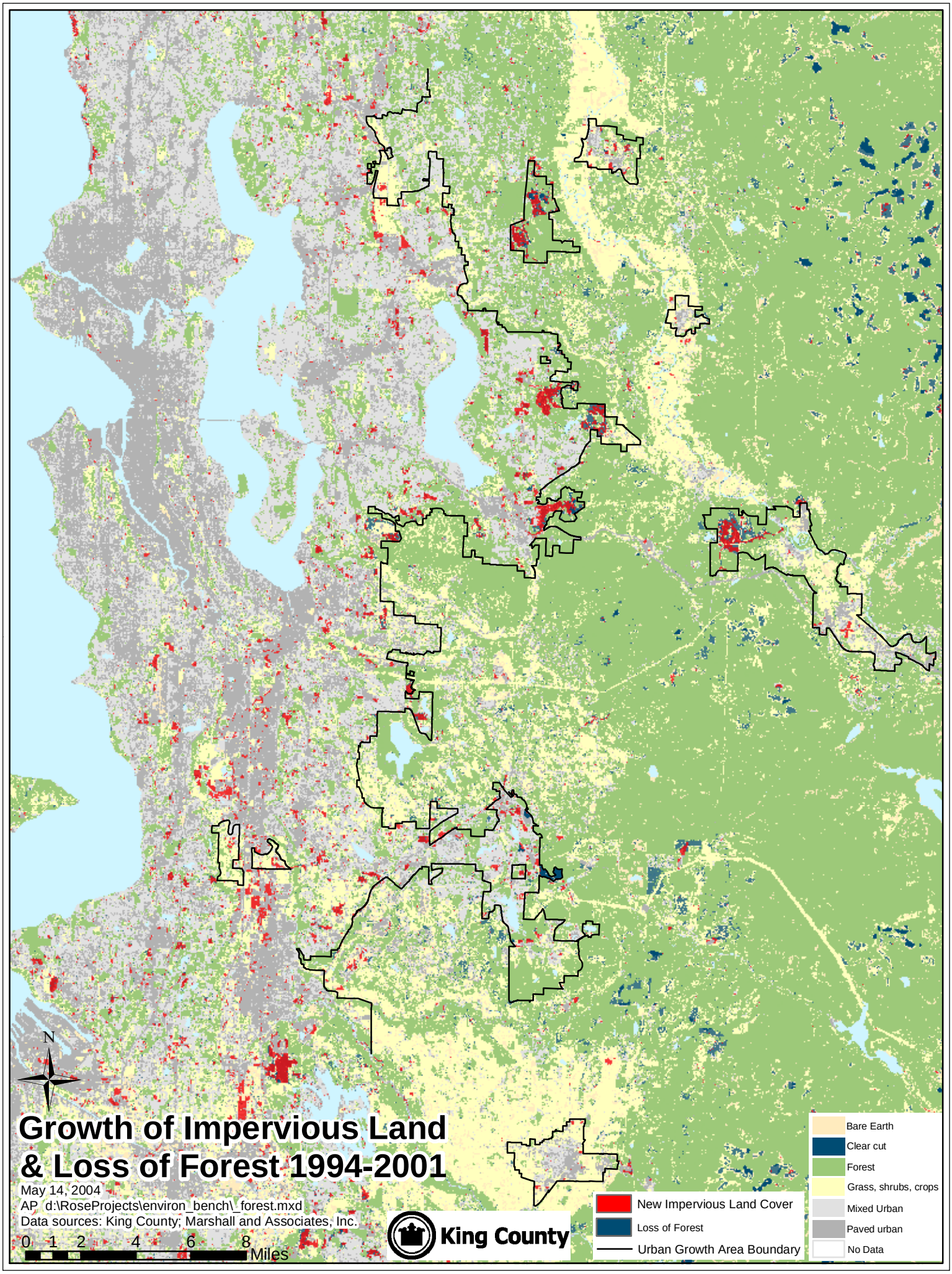
*This analysis depends on classification of Landsat data. The method used identifies the landcover type at a resolution of about 1,075 sq. yards or 20% of an acre. It detects changes in classification (i.e. predominant land cover) for areas about that size.

It shows just 6,150 acres of recent clear-cut, amounting to 0.7% of the total forest cover. It appears that forest regeneration is proceeding at a rate well over that of recent clear cutting.

- Vegetative cover, especially forest, performs significant ecological functions. Forests and other types of vegetation, absorb, filter, and slow surface water flow. They provide wildlife habitat, clean air, and are aesthetically pleasing. Fish and wildlife depend upon continuous, undisturbed habitat. When ecosystems become fragmented, fish and wildlife are prevented from meeting their need for food, water, cover, and space.

Change in Impervious Surface

- When the land in a watershed reaches 10 - 15 percent impervious surface (paved or built development not permeable by water) the area undergoes long-term, and probably irreversible, loss of aquatic system functions. This loss results in larger and more frequent surface water flows, with greater potential for flooding, decreased base flows (from groundwater) to streams, and increased water level fluctuations in wetlands and small lakes. Changes in flows have significant adverse impacts on plants, fish, and wildlife.
- In the urban area of King County, the rate of increase in impervious surface has accelerated over the last 20 years. By 1994, over 25% of the urban area was already paved or built, and by 2001, 31% had been paved or built.
- During the 7 years from 1994 to 2001, 1.1% of the County's total land area, or 5.3% of the County's urban area, changed from any other classification to the "impervious" classification.
- The red areas on the map show the regions that changed to impervious surface during the 1994 - 2001 period. As the map reveals, nearly all of the growth in impervious surface has been in the urban area, with just a few, small regions of the rural areas showing change to impervious surface.
- Keeping any change to impervious surface to a strict minimum in the rural areas is essential for protecting habitat, preventing flooding, and maintaining the "air cleaning" qualities of forest cover (e.g. creating "carbon sinks" which offset the negative effects of the $C0_2$ emissions which drive climate change.).
- King County's rural and forest areas remain relatively undeveloped, and therefore can continue to perform these critical ecological functions for our region as long as they are preserved.


N
Growth of Impervious Land
& Loss of Forest 1994-2001
May 14, 2004
AP d:\RoseProjects\environ_bench_forest.mxd
Data sources: King County; Marshall and Associates, Inc.
0 1 2 4 6 8
Miles
King County
New Impervious Land Cover
Loss of Forest
Urban Growth Area Boundary
Bare Earth
Clear cut
Forest
Grass, shrubs, crops
Mixed Urban
Paved urban
No Data

Outcome: Improve Air Quality

Indicator 10: Changes in Air Quality

Countywide Planning Policy Rationale

"All jurisdictions, in coordination with Puget Sound Air Pollution Control Agency* and the Puget Sound Regional Council, shall develop policies, methodologies and standards that promote regional air quality, consistent with the Countywide Policy Plan." (CA-14)

*Now the *Puget Sound Clean Air Agency*

Background

Air quality evaluation is a complex issue, involving measurement of short-term impacts on visibility, medium-term impacts on health and quality of life, and long-term impacts on climate. In this indicator we consider 1) the six traditional air pollutants which determine the daily air quality index; 2) air toxics which contribute to cancer and other health risks; and 3) greenhouse gases which contribute to climate change.

- The Air Quality Index (AQI), also known as the Pollutant Standards Index (PSI), provides a nationally uniform method of reporting daily air quality levels.
- There are six major pollutants that are considered in determing the AQI: 1. particulate matter (PM_{10} and $PM_{2.5}$); 2. carbon monoxide (CO); 3. sulfur dioxide (SO_2); 4. ozone (O_3); 5. nitrogen dioxide (NO_2); and 6. lead (Pb).
- The concentration of each of these pollutants on a given day determines the Index value; and the pollutant with the highest Index value determines the AQI on that day. These are then translated into "good", "moderate", unhealthful for sensitive groups" and "very unhealthful" categories.
- Air quality in western King County is primarily determined by the levels of particulate matter, sulfur dioxide, and carbon monoxide, rather than by lead, nitrogen oxide, or ozone.
- Ozone forms slowly, downwind of pollution sources, and contributes to smog. In King County, it travels southeast with the wind, and elevated levels are sometimes seen at the Enumclaw monitoring station, but typically not in the north and western parts of the County.

Fig. 10.1

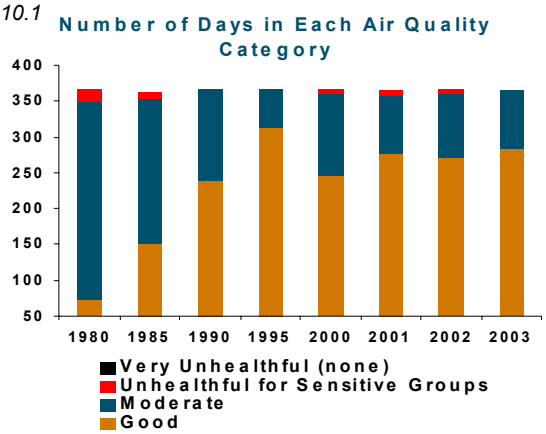


Fig. 10.2

Number of Days in Each Air Quality Category by Year

	1980	1985	1990	1995	2000	2001	2002	2003
Good	73	150	239	313	245	276	270	284
Moderate	275	202	126	52	116	83	91	81
Unhealthful for Sensitive Groups	18	10	0	0	5	6	4	0
Very Unhealthful	0	0	0	0	0	0	0	0

Key Trends

I. Traditional Air Pollutants

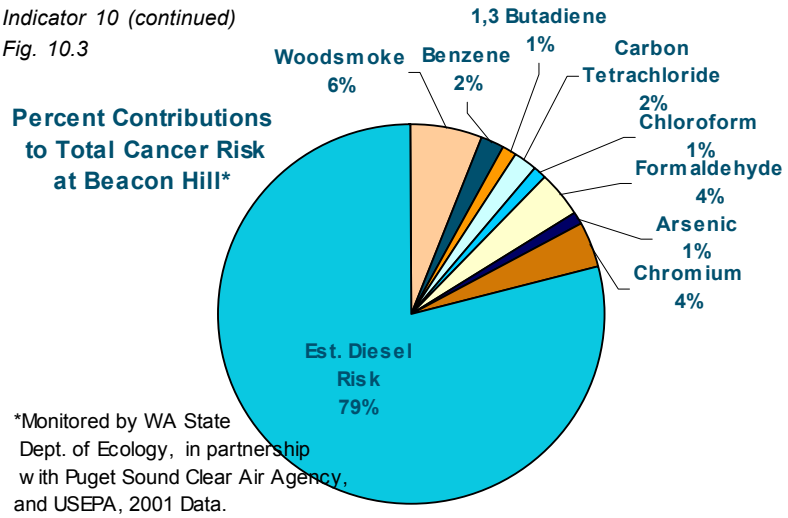
- The number of good air quality days in the greater Seattle / King County area was up to 284 in 2003, with the remaining 81 days in the moderate air quality category. There were no unhealthful days in 2003.
- This is the best year for air quality since 1998. It has been more challenging to achieve a moderate or good rating since higher federal air quality standards for particulate matter were implemented in 1999.
- As Fig. 10.1 shows, air quality as measured by the AQI has improved since 1980, with a growing number of good air days, and a declining number of days categorized as unhealthy for sensitive groups.
- Particulate matter is a significant pollutant and health hazard in King County. Particulate matter (PM) refers to the very small solid particles and liquid droplets formed when carbon fuels are burned.
- Exposure to elevated levels of particulate matter aggravates asthma, chronic pulmonary disease, and heart disease. Even small rises in PM appears to lead to increased asthma attacks. Asthma disproportionately affects the very young, the very old, and the very poor, and is a leading cause of school absenteeism.
- The major sources of PM pollution are motor vehicles, diesel trucks, or wood burning.
- Motor vehicles are by far the largest overall contributors to air pollution, responsible for about 55% of the total. Industry is responsible for about 21%, outdoor burning for 12%, and wood stoves and fireplaces for another 12%. Automobiles, trucks, and small engines, also contribute to ozone, and to other toxic chemicals in the air.
- Higher emission standards and improved regulatory enforcement have contributed to the long-term improvements in King County's air quality.

II. Air Toxics

- "Air toxics" is "a broad category of chemicals that covers over 400 air pollutants along with woodsmoke and diesel particles. They are of concern because of potential dangers to human health.

Indicator 10 (continued)

Fig. 10.3



*Monitored by WA State Dept. of Ecology, in partnership with Puget Sound Clear Air Agency, and USEPA, 2001 Data.

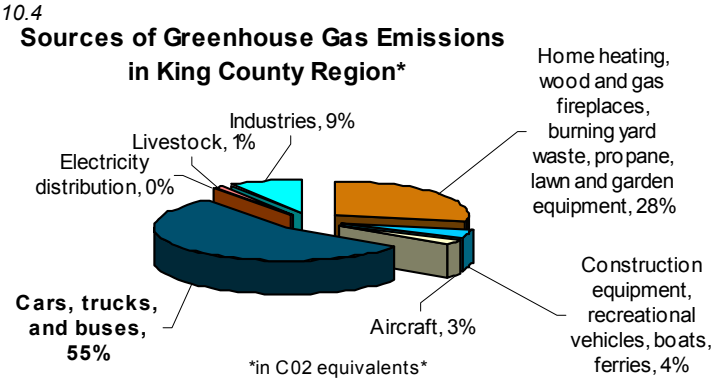
- The primary health concern from many of these chemicals is cancer - particularly lung, nasal and liver cancers, and leukemia. Respiratory and heart disease may also be aggravated by some of these same pollutants.
- Fig. 10.3 shows the percent contribution to total cancer risk by various air toxics, measured in 2001 at a Beacon Hill (Seattle) monitoring station. The highest risk comes from diesel soot and woodsmoke, along with benzene, butadiene, carbon tetrachloride and formaldehyde. Diesel emissions and woodsmoke together account for over 85% of the risk.
- The average cancer risk from these sources for a life-time resident of King County is in the range of 400 to 700 in a million. This would mean a risk of 2 - 3.5 cases out of 5,000 residents, or 700 - 1300 cases in a population of 1.8 million. Public health experts consider this unacceptably high.

III. Greenhouse Gases

Greenhouse gases are of concern because of their long-term effect on climate change, rather than because of their immediate impact on air quality. Although local data on greenhouse gases are not yet available, some general observations are included here, because many of the same activities that produce traditional pollutants also produce GHGs.

- Climate change is caused by increases in the concentration of "heat trapping" greenhouse gases in the atmosphere including carbon dioxide and methane.
- Greenhouse gases are released when humans burn fossil fuels to generate electricity and to power vehicles, as well as when waste is disposed. As Fig. 10.4 shows, at least 55% of King County emissions are from motor vehicles.
- Greenhouse gases are warming the earth and causing climate disruptions – more storms, more erratic weather, more rainfall and moisture, temperature changes and drought.

Fig. 10.4



- Scientists project that, due to rising temperatures, the Pacific Northwest can expect higher temperatures, wetter winters, drier summers, reduced river flows, increased coastal flooding and erosion and decreased forest health and productivity. Snowpack – the region's natural storage system for water supply and hydroelectricity - is likely to decline by half within our children's lifetimes.
- The sea level rose by 4"-8" in the last century. It is predicted to rise anywhere from 4 inches to nearly 3 feet during the current century.

For Comparison

- Global mean surface temperatures have increased about 1.0°F since the late 19th century, when accurate data became available. They are predicted to rise from 1° to 4.5° Fahrenheit in the next 50 years.
- The 20th century's 10 warmest years all occurred in the last 15 years of the century. 1998 is the warmest year on record. 2002, 2003, and 2001 now measure as the 2nd, 3rd, and 4th warmest years since the late 19th century. The eight warmest years all occured in the past nine years. (i.e. 1995 - 2003)

What We Are Doing

- Reducing diesel emissions through the Diesel Solutions program, a partnership among King County, Seattle, the Boeing Company, Durham School Services, and Phillips Petroleum, to bring cleaner diesel vehicles and fuels to our region.
- Encouraging use of non-diesel or clean diesel school buses and county vehicles, and fuel-efficient private vehicles.
- Promoting transit ridership, creating bicycle trails and lanes, and designing pedestrian-friendly urban environments to reduce fuel consumption.
- Encouraging proximity of jobs and housing to reduce commute distances and fuel consumption.
- Maintaining bans on outdoor burning and use of wood stoves or fireplaces. Replacing wood stoves or fireplaces with natural gas or propane which burn many times cleaner than wood.
- Preserving and regenerating urban trees and rural forest land to increase "carbon sinks" and counteract climate-changing $C0_2$ emissions.
- Educating business and industry on green building principles to reduce energy consumption.
- Meeting all electric power needs for Seattle City Light customers with no net greenhouse pollution.
- Updating greenhouse gas emissions inventories and setting targets for emissions reduction.

Outcome: Improve Air Quality

Indicator 11: Energy Consumption

Countywide Planning Policy Rationale

"In cooperation with water and electricity providers, local jurisdictions, including sewer and water districts, shall encourage programs for...power conservation in public facilities and in the private sector." (ED - 11) "Aggressive conservation efforts shall be implemented to address the need for adequate supply for electrical energy and water resources, and [to] achieve improved air quality. Efforts shall include, but not be limited to, public education...conservation credits, and energy efficiency in new and existing buildings." (CO, 6)

Key Trends

I. Washington State, U.S. and World

- Per capita energy consumption for Washington State was 369 million BTUs per person in 2000. This measure includes all end-use energy consumption - residential, commercial, and industrial.
- This is just slightly higher than the per capita consumption for the U.S. of 349 million BTUs. Washington State uses about 2.2% of all U.S. energy consumption.
- Per capita energy usage in Washington State has declined significantly from 1990 to 2000, while it has increased 3.3% throughout the U.S.
- Currently the U.S. uses 25% of the world's annual energy consumption with less than 5% of the world's population. Washington State with 0.1% of the world's population consumes about 0.5% of the world's energy each year. Only the United Arab Emirates, Bahrain, Kuwait, Canada and Norway consume more energy per capita than the U.S.

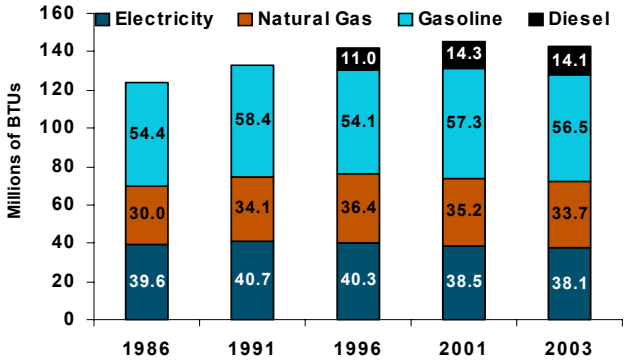
II. King County

- In King County, our per capita energy consumption from the four main sources - electricity, natural gas, automotive gas, and diesel - has increased 0.5% over the last seven years.
- During the same period, total energy consumption (not per capita) rose 8.8% while population grew at about 8.0%. Nearly all of this increase was in motor vehicle fuels.
- Per capita use of electricity and natural gas have both declined significantly since 1996, indicating that energy-efficient buildings, appliances, and other conservation measures are having a positive impact.
- However, the gains in energy conservation at home and at work are more than offset by the increase in gasoline and diesel usage. (Note that the increase in diesel usage may be slightly overstated due to changes in data collection method.)
- As the County's population grows, more miles are being driven in King County by both private and commercial vehicles. (See Indicator 12).

(continued on page 7)

Fig. 11.2

Per Capita Energy Consumption in King County: 1986 - 2003



*Diesel data w as not collected until 1996. Improved data collection methods may be partly responsible for the sharp rise in diesel usage from 1996 - 2001.

Fig. 11.3

Change in King County Energy Consumption per Capita by Energy Type: 1996 - 2003

In Millions of BTU's	1996	2001	2003	% Chg 1996- 2003
Electricity*	40.3	38.5	38.1	-5.2%
Natural Gas	36.4	35.2	33.7	-7.4%
Gasoline	54.1	57.3	56.5	4.3%
Diesel Fuel**	11.0	14.3	14.1	28.4%
Per Capita Energy Consumption***	141.8	145.3	142.5	0.5%

*Electricity includes both Seattle City Light and Puget Sound Energy consumption. **Improved methodology may account for the rapid rise in diesel from 1996 - 2001. ***This total is not comparable to state and national totals because the latter include energy usages, such as aviation and jet fuel, and wholesale energy production from coal, that are difficult to account for at the County level.

Fig. 11.1

Total and Per Capita Energy Consumption: Washington State, U.S. and World: 1990 and 2000

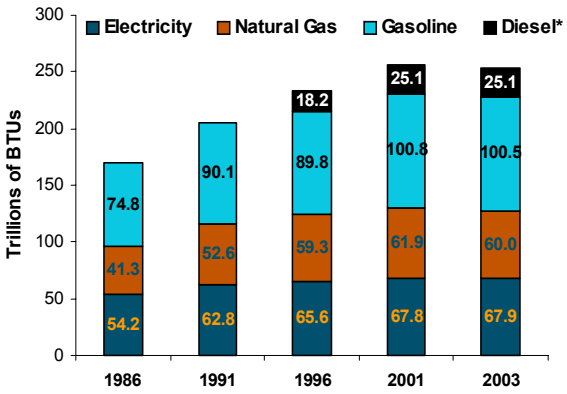
	Total Energy Consumed (in Trillions of BTUs)		Per Capita Energy Consumed (in Millions of BTUs)		Change in Per Capita Consumption	Percent of World Consumption	Rank in Per Capita Consumption)
	1990	2000	1990	2000	1990-2000	2000	2000
Washington State	2,049	2,174	421	369	-12.4%	0.5%	20th among U.S. states
United States	84,094	98,216	338	349	3.3%	25%	6th among 70 countries*
World	348,400	398,900	66	66	-0.1%	100%	

Source: Statistical Abstract 2003 and U.S. Dept. of Energy, Energy Information Administration (http://www.eia.doe.gov/emeu/states/_states.html) *The 70 countries exclude the least developed countries whose energy consumption is extremely low.

Indicator 11 (continued)

- Neither fuel efficiencies nor reductions in per capita vehicle use have been sufficient to compensate for this growth in commercial and personal travel. In fact, the U.S. EPA reports that the average fuel efficiency of 2002 model cars and trucks, at 20.2 mpg, was at its lowest level since 1980. Over time less efficient new cars will result in a less efficient national vehicle fleet than we have currently.
- This type of energy consumption is particularly troubling, since automotive and diesel emissions are responsible for most of the County's air pollution.
- The county measure includes end-use residential and commercial electricity and natural gas consumption, as well as automotive and diesel fuels. However, it does not account for home heating oil, or for certain industrial energy consumptions, such as aviation fuel, biofuels (wood-burning) or coal-generated power. For this reason, it is not strictly comparable to the state and national consumption figures in Fig. 11.1 which are more all-inclusive.

Fig. 11.4 **Total Energy Consumption in King County: 1986 - 2003**



**Diesel data was not collected until 1996. Improved data collection methods may be partly responsible for the sharp rise in diesel usage from 1996 - 2001.*

Outcome: Improve Air Quality

Indicator 12: Vehicle Miles Traveled (VMT) Per Year

Countywide Planning Policy Rationale

"All jurisdictions, in coordination with Puget Sound Air Pollution Control Agency* and the Puget Sound Regional Council, shall develop policies, methodologies and standards that promote regional air quality, consistent with the Countywide Policy Plan." (CA-14) "The land use pattern for King County shall protect the natural environment by...concentrating development" (FW-6) "The land use pattern shall be supported by a balanced transportation system which provides for a variety of mobility options....(FW-18) The transportation element of Comprehensive Plans shall include pedestrian and bicycle travel as part of the transportation system....(T-7) "General capacity improvements promoting only single-occupant vehicle traffic shall be a lower priority." (T-8)

*Now the *Puget Sound Clean Air Agency*

Background

This indicator measures all vehicle miles traveled (VMT) in a given year on the streets and highways of King County, whether by commercial or private vehicles. It also measures per capita miles traveled to account for the growing population in the County. Because commercial vehicle miles are included, the degree of economic activity will influence the total, as well as the driving patterns of private households.

Key Trends

- In 2002 vehicles in King County traveled a total of 16.3 billion miles. This is 90% more than the number of miles traveled in King County in 1985. Population has grown by only about 31% during the 1985 - 2002 period.

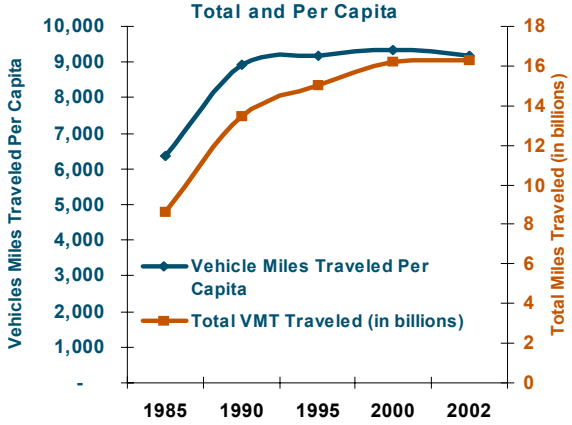
Fig. 12.1

Vehicle Miles Traveled: Per Capita and Total

Year	1985	1990	1995	2000	2002
Vehicle Miles Traveled Per Capita	6,344	8,933	9,154	9,322	9,174
Total VMT Traveled (in billions)	8.6	13.5	15.0	16.2	16.3

Fig. 12.2

Vehicle Miles Traveled in King County: Total and Per Capita



- Including changes in commercial traffic, King County residents are driving about the same amount *per capita* as they did in the mid-nineties, but they are driving 45% more than they did in 1985.
- In 2002 VMT per capita stood at 9,174 miles per year, slightly higher than the per capita VMT figure of 9,154 in 1995. It had risen to 9,322 in 2000 at the height of the most recent economic boom, but dropped with the recession. In 1985, the per capita VMT was just 6,344 miles.
- With both population and economic growth, more vehicles are traveling more miles, using up more gasoline and diesel fuel (see Indicator 11), and emitting a higher volume of pollutants into the air (see Indicator 10).
- 53% of all air pollution is caused by vehicle emissions, and diesel soot is responsible for 79% of cancer risk from toxic emissions in our area.
- It will take a variety of measures to halt this growth of harmful emissions: total and per capita miles traveled need to be reduced, alternate travel modes encouraged, and more efficient vehicles with cleaner fuels employed.

Outcome: Protect Water Quality and Quantity

Indicator 13: Surface Water Quality

Countywide Planning Policy Rationale

"Natural drainage systems including associated riparian and shoreline habitat shall be maintained and enhanced to protect water quality, reduce public costs, protect fish and wildlife habitat, and prevent environmental degradation. Jurisdictions with shared basins shall coordinate regulations to manage basins and natural drainage systems which include provisions to: a. Protect the natural hydraulic and ecological functions of drainage systems, maintain and enhance fish and wildlife habitat, and restore and maintain those natural functions; b. Control peak runoff rate and quantity of discharges from new development to approximate pre-development rates; and c. Preserve and protect resources and beneficial functions and values through maintenance of stable channels, adequate low flows, and reduction of future storm flows, erosion, and sedimentation." (CA-9) "All jurisdictions shall implement the Puget Sound Water Quality Management Plan to restore and protect the biological health and diversity of the Puget Sound Basin." (CA-15) "Each jurisdiction's policies, regulations, and programs should effectively prevent new development and other actions from causing significant adverse impacts on major river flooding, erosion, and natural resources outside their jurisdiction." (CA-12)

I. King County Lakes: Background

Eutrophication refers to the biological activity in a lake, reflecting the natural aging process. Lakes age over time and gradually fill in, becoming ponds, marshes, wetlands and eventually forests. Measuring lake eutrophication is one of the most common ways to assess lake health.

Carson's (1977) trophic state index (TSI) is a method of quantifying this eutrophication on a scale of 0 - 100. Lakes with values around 40 or less (oligotrophic) have high water clarity, lower algae values, and lower total phosphorus values.

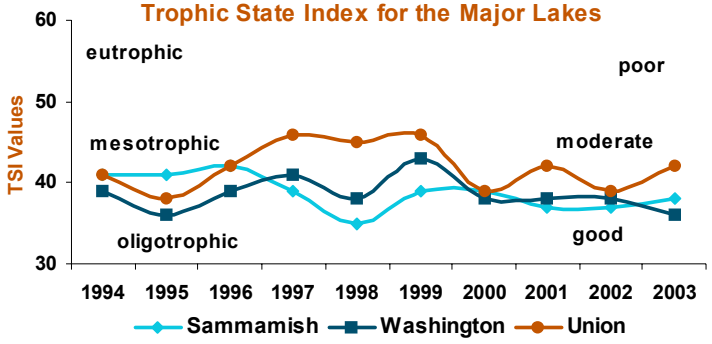
Lakes with TSI values between 40 and 50 (mesotrophic) have moderate water clarity, algae and phosphorus values. Lakes represented by TSI values between 50 and 60 (eutrophic) typically have poorer summer water quality including lower water clarity, higher chlorophyll a values and higher total phosphorus values. Hypereutrophic lakes have TSI values greater than 60 and are very biologically productive. They have wetland-type attributes. The TSI values are a continuum and hence some lakes may be in a borderline range, exhibiting some qualities of upper and lower classifications.

Key Trends

- King County's three major urban lakes - Lake Union, Lake Sammamish, and Lake Washington - are in moderate to good condition.
- Lake Union remains in the mesotrophic category, with moderate algal growth and moderate water clarity. Its status is about the same as it was in 1995.
- Lake Sammamish has show the most improvement over the past decade, moving from moderate to good status, and maintaining that status over the last five years. Lake Washington has also shown a slight improvement.

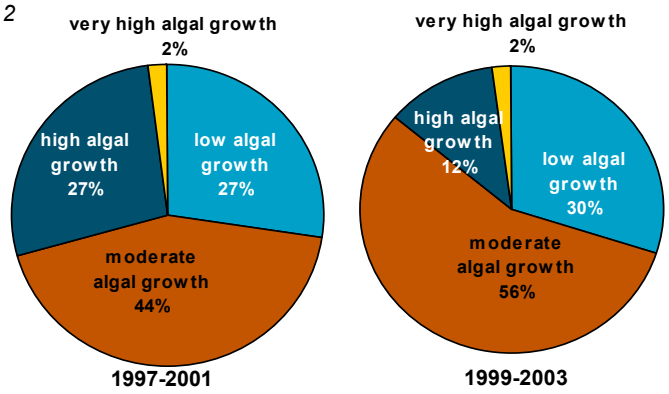
Fig. 13.1

Summer Average (June-Sept) Trophic State Index for the Major Lakes



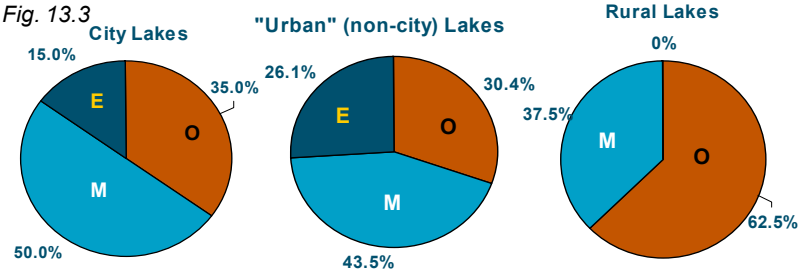
- There are 50 small lakes that have been monitored for trophic status. Comparisons of five-year averages over time are shown in Fig. 13.2. Overall, the percentage of lakes producing high algal growth appears to be decreasing. Among the monitored lakes, only Allen Lake continues to be hypereutrophic, having very high algal growth.

Fig. 13.2



- None of the rural lakes were classified as hypereutrophic or eutrophic (having high algal growth), while about 15% of the lakes in citieswere classified as "eutrophic". Surprisingly, non-city lakes close to urban areas, had the highest proportion (26%) of lakes with high algal growth.

Fig. 13.3

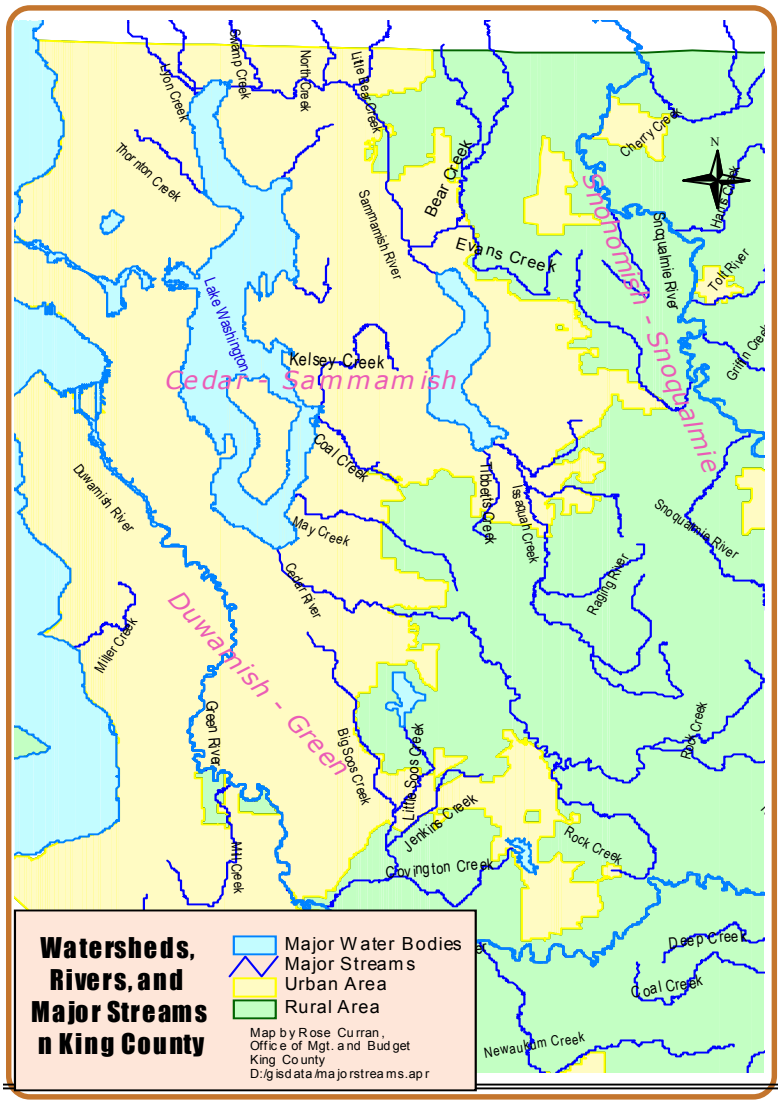


E = Eutrophic M = Mesotrophic O = Oligotrophic

(continued on page 9)

Indicator 13 (continued)

Fig. 13.4



II. King County Streams: Background

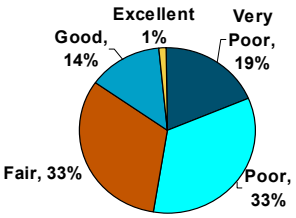
Stream quality can be measured in a number of ways. The Benthic Index of Biotic Integrity (B-IBI), reported for this indicator, is a kind of "report card" of stream health. The B-IBI measures the quantity of certain aquatic macro-invertebrates present in a stream sample. The number and condition of these macroinvertebrates yield 10 measures, each of which is assigned a score from 1 (severe degradation) to 5 (little or no degradation). The rating scale from 10 - 50 indicates whether the stream is in very poor (score of 10 - 16), poor (18 - 26, fair (28 - 36), good (38 - 44), or excellent (46 - 50) condition.

Other types of water quality parameters include measures of turbidity, pH, summer temperature, summer dissolved oxygen, and the presence of fecal coliform, e.coli, or Enterococcus bacteria. Currently no trend data is available on these measures. B-IBI scores have been available for many King County streams since 1995, but sampling has been incomplete and sporadic. Because the 2002 sampling efforts included more data than all previous years combined, these data represent the best available baseline. Sampling for 2002 was conducted using a randomized design for streams in both incorporated and unincorporated King County. Streams in eighteen sub-basins were sampled at a total of 144 monitoring stations.

Key Trends

- 52% of the sampled streams in King County are in poor or very poor condition, based on their 2002 B-IBI scores.
- One-third of the streams are in fair condition, while just 15% are in good or excellent condition.
- King County Department of Natural Resources (DNRP) has set a five-year target of reducing the number of poor and very poor stations to under 50%, and raising the number of stream stations rated as good or excellent to 18%.

Percent of Stream Stations in Each Condition Category



- The Lower Cedar River tributaries, Soos Creek, Bear Creek, and Issaquah Creek were sampled occasionally from 1994 - 2001. The overall trend, especially for the number of stations receiving a good or excellent rating, is downward, although changes in station locations and sampling intensity make comparisons difficult.

(continued on page 10)

Fig. 13.5

Condition of King County Streams: 2002

	Number of Stations	Average B-IBI Score	Average Rating
Urban Area Streams			
Urban-Rural Fringe			
Mainly Rural			
Lake Washington / Cedar River Sub-Basins			
West Lake Washington	9	19	Poor
North & Swamp Creeks	5	19	Poor
East Lake Washington	9	24	Poor
Little Bear Creek	7	26	Poor
Evans Creek	9	28	Fair
Bear Creek	10	29	Fair
Sammamish River	10	22	Poor
Cedar River	10	31	Fair
Lake Sammamish / Issaquah Creek Sub-Basins			
Lake Sammamish Tributaries	4	23	Poor
Issaquah Creek	7	37	Good
Duwamish - Green River Sub-Basins			
Black River	9	18	Poor
Duwamish River Tributaries	5	18	Poor
Lower Green River Tributaries and Mill Creek	9	22	Poor
Jenkins and Covington Creeks	10	29	Fair
Soos Creek	10	29	Fair
Newaukum Creek	8	33	Fair
Middle Green River	8	34	Fair
Deep and Coal Creeks	5	38	Good

Indicator 13 (continued)

- Generally, the sub-basins that are completely within the urban (developed) area tend to be in poor or very poor condition, while those that flow mainly through rural areas are more likely to be in good or excellent condition. Those that are on the fringes of the urban area are likely to be in fair condition.
- Recent studies of the overall environmental quality of the King County sub-basins showed a high correlation between the B-IBI index scores, and two other measures of environmental health - 1) percent of vegetative cover; and 2) road density in the sub-basin.
- These studies found that the environmental quality of 88% of the acreage in the rural sub-basins is medium-high or high, while only 3% of the acreage in the urban sub-basins is of medium-high quality. (See Indicator 17).

III. Marine Water Quality: Background

Marine water quality is monitored in several ways: 1) amount of dissolved oxygen; 2) marine sediment chemistry associated with adverse biological effects; and 3) presence of fecal coliform and Enterococcus bacteria in the marine environment.

Dissolved oxygen is an important measure for determining whether the waters are generally capable of sustaining various aquatic organisms, including sensitive fish and invertebrate species. The Water Quality Standard for dissolved oxygen is 7.0 mg/L. This standard is not attained at all times of the year, often due to naturally occurring conditions, so there is also a 5.0 Water Quality Guideline that is used as a warning limit, below which aquatic life may be harmed.

Many marine pollutants are not detected in water, but are attached to sediment particles. These can directly harm marine organisms or be reintroduced into the food chain. The most protective standard for marine sediments is the Sediment Quality Standard (SQS) indicating there are "no adverse effects" on the marine environment. The CSL or "Cleanup Screening Level" indicates "minor adverse effects" from pollutants. Sites falling between these two standards normally do not require clean-up.

Measures of fecal coliform and Enterococcus bacteria are indicators of fecal contamination from animals or humans which can be accompanied by pathogens harmful to human health. These bacteria can enter the aquatic environment in a number of ways, including stormwater runoff or untreated wastewater effluent.

Outfall sites are those situated close to a known source of pollution, while ambient sites are those away from any known point source. For fecal contamination, offshore sites are measured separately from beach sites.

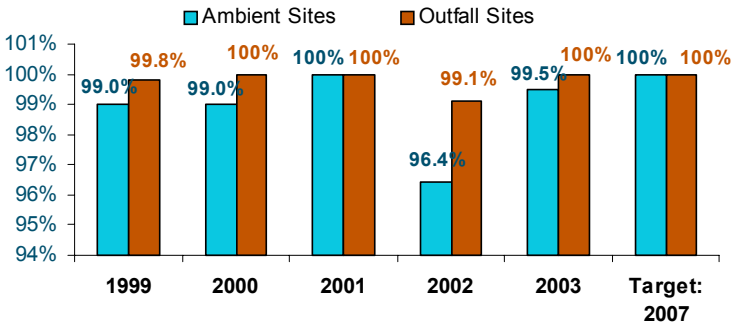
Key Trends

- Overall, marine water quality is good as measured by the dissolved oxygen standard, and offshore sites show little fecal coliform contamination.
- However, measures of marine sediment show need for improvement, and a number of beach sites, both ambient and outfall, do not meet the current standards for Enterococcus bacteria.

Amount of Dissolved Oxygen

- 100% of outfall sites and 99.5% of ambient sites met the Water Quality Guideline of 5.0 mg/L for dissolved oxygen in 2003.

Fig. 13.6 **Percent of Samples that Met Marine Water Quality Guideline for Dissolved Oxygen (5.0 mg/L)**



- 62.3% of outfall sites and 55.1% of ambient sites met the more stringent Water Quality Standard of 7.0 mg/L for dissolved oxygen. The target is that 100% of all sites meet the Water Quality Guideline of 5 mg/L, and 60% of all sites meet the Water Quality Standard by 2007.
- Since there is little difference between the outfall and ambient sites, it is not likely that effluent from outfalls is affecting dissolved oxygen concentrations.

Marine Sediment Quality

- There are fifteen outfall sites (54%) that fail to meet the Sediment Quality Standard (SQS). Of these fifteen, seven exceed the Cleanup Screening Level (CSL) and require clean-up. One was the result of an emergency overflow, and the other six were due to combined sewer overflows rather than wastewater outfalls.
- There are two ambient sites the don't meet the SQS, but do meet the CSL, and thus do not require clean-up. The long-term goal is that all sites will meet the Sediment Quality Standard.

Presence of Fecal Coliform or Enterococcus Bacteria

- In 2003, 100% of offshore sites (both ambient and outfall sources) met the Class AA marine surface water fecal coliform standard. This standard addresses water quality requirements for classifying shellfish growing areas and for protecting primary contact recreational users.
- As recommended by the U.S. EPA, King County has begun to implement a state guideline using Enterococcus bacteria to assess beach water quality.
- This standard addresses human health effects from direct contact with marine waters through swimming, wading, SCUBA diving, or surfing.
- In 2003, 69% of 13 ambient beach sites met the new Enterococcus standard, while 67% of 5 outfall sites met the standard. The goal is to meet the standard at 90% of ambient sites, and 75% of outfall sites by 2007.

Indicator 13 (continued)

What We Are Doing

- Sponsoring the Basin Stewardship Program. Improving drainage systems and run-off in urban areas, and providing better flood control.
- Carrying out in-stream habitat restoration. Sponsoring volunteer programs.
- Mitigating development activities that may affect surface water quality. Limiting new impervious surface in rural areas where stream health can be maintained.
- Providing citizen education such as the Hazardous Waste Education Program.
- Implementing wider stream buffers in rural King County as needed to protect fish habitat. Removing culverts or other impediments to fish migration.
- Carrying out Lake Management Plans in five smaller lakes (Cottage Lake, Lake Sawyer, Lake Desire, Beaver Lake I, and Beaver Lake II).
- Completing the Henderson/M.L.King project to eliminate overflows from sewers into Lake Washington during extreme storms.
- With Seattle, implementing the Denny/Lake Union Project to reduce the volume and frequency of combined sewer overflows to Lake Union and Elliott Bay.
- Working with City of Seattle on long-range plans to control sewer overflows within the city at several other sites.
- Implementing capital improvement programs under the Regional Wastewater Service Plan to improve water quality at beach sites.
- Continuing to monitor marine outfalls to assure that we are treating and transporting wastewater effectively, and upgrading Vashon wastewater treatment plant.
- Cleaning up sites not meeting marine sediment standards as part of the Lower Duwamish Waterway Superfund project.

Outcome: Protect Water Quality and Quantity

Indicator 14: Water Consumption

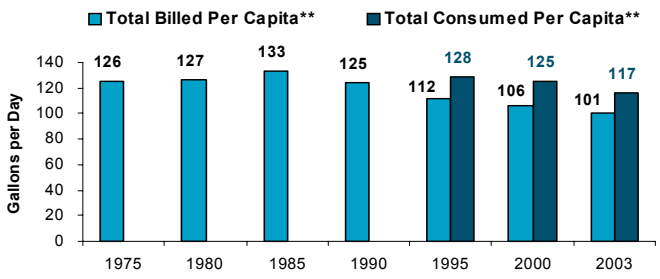
Countywide Planning Policy Rationale

"Water supply shall be regionally coordinated to provide a reliable economic source of water and to provide mutual aid to and between all agencies and purveyors. The region should work toward a mechanism to address the long-term regional water demand needs of all agencies and water purveyors." (CO-5) "Aggressive conservation efforts shall be implemented to address the need for adequate supply for...water resources....Efforts shall include...public education, water reuse and reclamation, landscaping which uses native and drought-resistant plans and other strategies to reduce water consumption..."(CO-6) "Water reuse and reclamation shall be encouraged, especially for large commercial and residential developments, and for high water users such as parks, schools, golf courses, and locks." (CO-7)

Key Trends

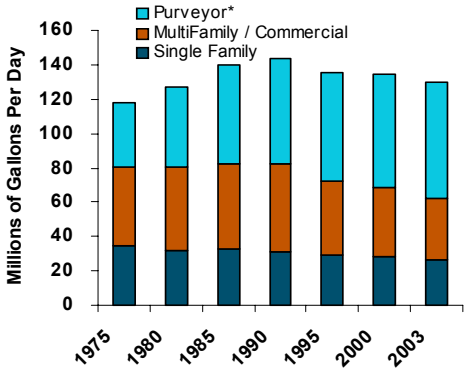
- Water consumption in King County has continued its downward trend since 1985. We now consume 24% less water per person than in 1985.
- Total consumption has also declined since 1985 - by about 7.6%.
- A recent University of Washington study concluded that over the next 50 years, the Pacific Northwest will experience "warmer, wetter winters and hotter summers [which] will reduce winter snowpack, increase winter run-off and flooding...and reduce summer water supply and water quality."
- With climate change and a growing population, progress in water conservation is still needed.

Per Capita Water Consumption in King County: 1975 - 2003



" Total billed" w ater includes all w ater paid for by customers, w hether retail or w holesale (i.e. paid for by other purveyors). "Total consumed" includes non-revenue w ater used up in transmission leaks, cleaning lines and reservoirs, etc. This number has only been tracked since 1995.

Billed Water Consumption By Sector in King County: 1975 - 1999*



- While residential water use has declined steadily, there is less evidence for a decline in commercial use.
- Much more water is being sold to other purveyors than in 1975 - 1985.

The **King County *Countywide Planning Policies* Benchmark Program** is a program of the Metropolitan King County Growth Management Planning Council. Reports on the 45 Benchmark Indicators are published annually by the King County Office of Budget. A companion to these reports is the **King County Annual Growth Report.** All reports are available on the Internet at http://www.metrokc.gov/budget/. For information about the **Benchmark Program**, please contact Rose Curran, Program Manager (206) 205-0715, or e-mail: rose.curran@metrokc.gov. The Benchmark Program address is King County Office of Budget, Room 406, King County Courthouse, Seattle, WA 98104.

King County Office of Budget
Steve Call, Director;
Chandler Felt, Demographer/ Growth Information Team Lead;
Rose Curran, Benchmark Program Coordinator, Lead Analyst;
Nanette M. Lowe, Growth Information Team, G.I.S. Analyst; Aimee Pierce, Intern

Outcome: Protect Water Quality and Quantity

Indicator 15: Groundwater Quality and Quantity

Countywide Planning Policy Rationale

"All jurisdictions shall adopt policies to protect the quality and quantity of groundwater where appropriate..." (CA-5) "Land use actions should take into account the potential impacts on aquifers determined to serve as water supplies. The depletion and degradation of aquifers needed for potable water supplies should be avoided or mitigated, otherwise a proven, feasible replacement source of water supply should be planned and developed to compensate for potential lost supplies." (CA-6)

Background

Groundwater is a significant natural resource in King County, providing safe drinking water for approximately 30% of the county's population through thousands of water wells. In rural parts of the county, groundwater is often the only feasible source of water for domestic or other uses. During the summer and fall, when rain rarely falls, groundwater provides the base flow in streams that is necessary to maintain fish and other wildlife habitat.

King County looks for trends in groundwater quality by (1) tracking levels of the constituents (such as arsenic, lead and nitrate) identified in federally regulated primary drinking water standards, and (2) looking for statistically significant trends in nitrate levels, even if the levels are well below the drinking water standards. Nitrate is an appropriate constituent to evaluate because it is a good indicator of overall water quality changes caused by human activities, such as land use development, and because the necessary data are collected on a frequent basis.

Preservation of groundwater quantity is necessary to maintain the availability of water for potable use and the availability of groundwater that supports base flows in streams and other surface water bodies. Reductions in groundwater levels can put ecosystems and residents who rely on these water supplies at risk. Changes in land use and/or vegetation, increases in groundwater withdrawals, and climatic changes can adversely affect the quantity of groundwater. Systematic, long-term measurements of aquifer water levels (either taken from water wells or dedicated monitoring wells) are the best way to track changes in groundwater quantity.

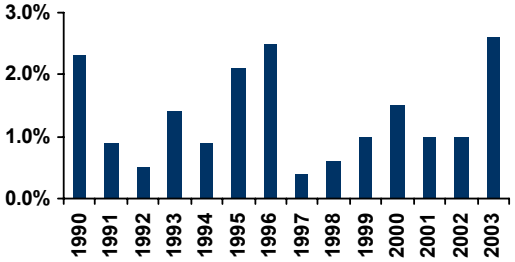
Key Trends

I. Groundwater Quality

- In 2003, all reporting public water supply sources (wells) in King County met the primary (health based) drinking water quality standards. These standards are adopted by the United States Environmental Protection Agency and by the Washington State Board of Health.
- The reported and measured levels of arsenic in 2003 appeared to be stable or decreasing. However, close to 10% of King County's public water supply sources could become out of compliance when the drinking water standard for arsenic is reduced from 50 ppb to 10 ppb in 2006. Arsenic is a naturally occurring element often found in deeper wells near bedrock.
- The past 14 years have seen fluctuations in the percentage of public water supply sources with elevated nitrate levels. In 2003, 2.6% of the sources reported elevated nitrate levels.

Fig. 15.1

Percentage of Public Water Supply Sources with Elevated Nitrate Levels*



*Elevated nitrate levels are those greater than 5 mg/L, or 1/2 the drinking water standard.

Notes

These numbers include all nitrate monitoring results reported to the Washington State Department of Health by the public water supply groundwater sources.

High nitrate concentrations represent a health hazard to infants and susceptible populations.

- In most parts of the County, the nitrate levels reported in 2003 had increased from previous years. The East King County and Vashon-Maury Island Groundwater Management Areas showed the sharpest increase in reported nitrate levels.

Fig.15.2

Percentage of Sources with Significant Changes in Groundwater Nitrate Levels

Area	% Increased	% Decreased	% Unchanged
East King Co.	30	0	70
Issaquah Creek Valley	19	6	75
Redmond-Bear Creek Valley	17	17	67
Vashon-Maury Island	29	10	62
South King Co.	24	21	55
Other	35	11	54
Countywide	**28**	**12**	**60**

Notes

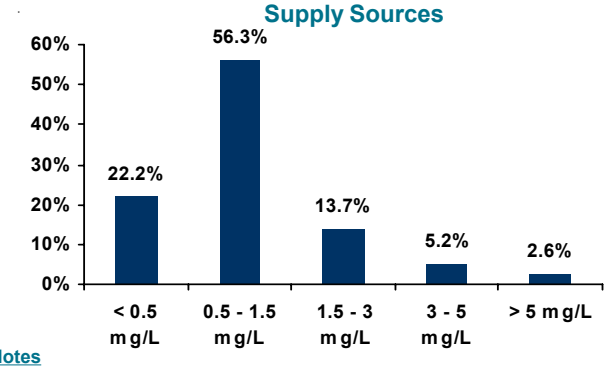
All changes are statistically significant at a 95% confidence rating.

A public water supply groundwater source had to have at least one sample in 2003 and at least three previously recorded nitrate levels to be included in this analysis.

- Although there is an upward trend in groundwater nitrate levels, the vast majority of nitrate levels throughout King County were very low in 2003, with almost 80% of the reported values below 1.5 mg/L.
- A number of public water supply sources in King County exceeded secondary drinking water quality standards in 2003. Water that exceeds these standards does not pose a health risk but may have undesirable aesthetic qualities, such as poor taste or color.

Indicator 15 (continued)
Fig. 15.3

Distribution of 2003 Nitrate Levels in Public Water Supply Sources



Notes
The federally regulated drinking water standard for nitrate is 10 mg/L. None of the 2003 samples exceeded this standard.
Nitrate levels were reported for 270 sources (wells) in 2003.

II. Groundwater Quantity

- There are currently insufficient water level data available within King County to track changes in water levels. However, the Seattle-King County Department of Public Health received notice of at least 20 wells going dry in 2003; the majority of these wells were private wells serving one household.
- A team of volunteers on Vashon-Maury Island records water levels monthly. These data show minor decreases in water levels over the past couple of years. These decreases may be caused by lower-than-normal aquifer recharge due to precipitation variations.

What We Are Doing

The King County Department of Natural Resources and Parks, as lead agency for the county Groundwater Protection Program, is leading several efforts related to this indicator:

- Investigating local groundwater concerns, particularly in those areas suspected of contamination and other water supply issues.
- Monitoring, modeling and analyzing Vashon-Maury Island's water supply in response to water level and nitrate trends.
- Participating in a study along the Sammamish River that will provide better information on the relationship between groundwater and flows in the river. The Sammamish River currently has water quality, temperature and low flow conditions that adversely affect fish populations.
- Providing water conservation education to groundwater consumers and to schoolchildren to allow them to teach their parents.
- Working with local Water Resource Inventory Area salmon conservation groups on groundwater components in habitat protection and restoration, and with ESA groups to include groundwater protection in species protection plans.
- Supporting Groundwater Protection Committees made up of local stakeholder interests in implementation of their local Groundwater Management Plans.
- Working with Public Health - Seattle & King County, the King County Department of Development and Environmental Services, and other local and state agencies or programs to identify groundwater quality and quantity concerns and to coordinate response and protection efforts.
- Developing a long-term work plan for protecting East King County's groundwater resources.
- Developing a comprehensive groundwater data collection and management system for planning and protection purposes.
- Monitoring water quality and quantity (water levels) at representative well locations in two King County Groundwater Management Areas and within other areas as funding permits.
- Restricting potentially dangerous land uses in areas considered highly susceptible to groundwater contamination.
- Limiting the amount of impervious surfacing and tree clearing in rural areas to protect aquifer recharge.
- Promoting low impact development and infiltration-based stormwater control to protect the quantity of aquifer recharge.
- Encouraging Best Management Practices that reduce the risk of chemical or biological contamination of groundwater.
- Educating homeowners about proper maintenance of septic systems in order to prevent groundwater pollution, and notifying well owners of water quality problems.

Outcome: Protect Wetlands

Indicator 16: Change in Wetland Acreage and Functions

Countywide Planning Policy Rationale

"In the long-term, all jurisdictions shall work to establish a single Countywide classification system for wetlands." (CA-2) "Within each basin, jurisdictions shall formulate their regulations and other non-regulatory methods to accomplish the following: protection of wetlands; assure no-net-loss of wetland functions, and an increase of the quantity and quality of wetlands. The top class wetlands shall be untouched." (CA-3) "Implementation of wetland mitigation should be flexible enough to allow for protection of systems or corridors of connected wetlands. A trade-off of small, isolated wetlands in exchange for a larger connected wetland system can achieve greater resource protection and reduce isolation and fragmentation of weltand habitat." (CA-4)

Background

The base wetlands acreage data in Fig. 16.1 and on the map are derived from several sources: the National Wetlands Inventory, created in 1989 from photos taken in the 1970s and 1980s, and the King County GIS Wetlands Coverage, created in 1995 and updated in 2000. These two sources have many wetland areas in common, but each contains some wetlands not identified by the other source. The data on wetland gain and loss is derived from the 1992 and 2001 Landsat data.

An accurate, current account of the number of acres in wetlands is very difficult to achieve. The numbers given Fig. 16.1 are subject to several possible sources of error: a) Both the baseline datasets depend on surveys or photos which are likely to be somewhat out of date; b) Wetlands and open water areas (rivers, lakes, and bays) are often adjacent to each other so that it is difficult to separate one from the other – they change with the seasons and the year's weather conditions; c) the overlap in the two data sets makes it challenging to ascertain how much total acreage is in wetlands without double-counting or undercounting.

In addition, the effort to calculate change in wetland areas between one year and a later year is also fraught with difficulty. This analysis depends on classification of Landsat data. The method used identifies the landcover type at a resolution of about 1,075 sq. yards or 20% of an acre. It detects changes in classification (i.e. predominant land cover) for areas about that size. Although great care is taken to classify the wetland areas in the same way, some of the variation detected in wetlands from 1992 to 2001 may be due to variable conditions on the days images were taken. Wetlands may shrink or expand naturally, depending on recent rain, drought, or snow melt. The acreages given should be taken as broad estimates rather than precise measurements.

Fig. 16.1

Change in Wetlands in King County : 1992 - 2001		
	Acres Gained or Lost*	Chg as % of total County land area
Est. Total Wetland Acreage c. 1992*	32,300	
Wet Areas Lost	2,375	0.17%
Wet Areas Gained	4,009	0.29%
Wet Areas (Net Gain)	1,634	0.12%
Est. 2001 Wetland Acreage	34,000	

*Open water is not included in the wetland acreage given here.

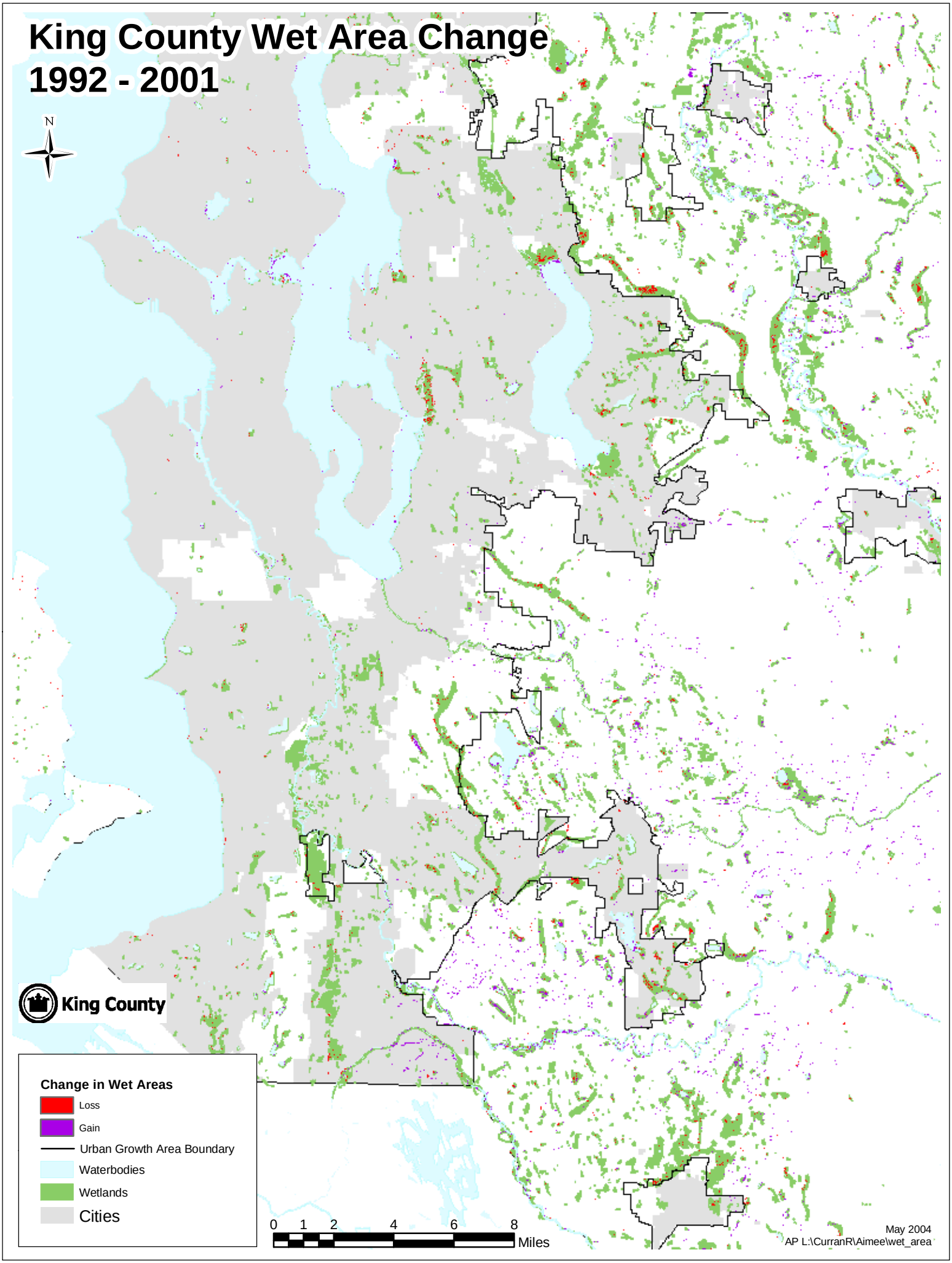
Key Trends

- King County has a total of about 32,000 - 34,000 acres of identified wetlands.
- It appears that there was no net loss of wetland area between 1992 and 2001.
- The 2001 Landsat data shows about 1,600 more acres of wetland than in 1992 (an increase of about 0.12% of County land area). However, it is likely that some of that gain is due to variable conditions on the particular days that the Landsat images were taken.
- Wetlands are valuable for many of the functions they provide. These include stormwater control, groundwater recharge, water quality protection and open space.
- From a biological perspective, wetlands are also highly productive ecosystems which are home to a vast diversity of species, including birds, fish, reptiles, invertebrates and mammals. The wetland habitat provides feeding, cover, nesting and breeding areas for these varied species.
- At least one-third of Washington State's threatened and endangered species require wetlands for their survival.

What We Are Doing

- Adopting statewide wetlands rating system, increasing buffers between wetlands and development activity, and strengthening related critical areas ordinances.
- Providing flood control, since unmanaged run-off is one of the greatest threats to healthy wetlands and streams.
- Providing the opportunity for wetland mitigation banking, which involves purchasing property and converting it to a wetland to compensate for wetland damage at another site.
- Combatting the growth of Purple Loosestrife, a non-native plant that overtakes wetland areas, replaces valuable native plants, and harms the habitat.
- Sponsoring the Small Habitat Restoration Program which rehabilitates streams and wetlands in small projects throughout the County.

King County Wet Area Change
1992 - 2001



Outcome: Protect the Diversity of Plants and Wildlife

Indicator 17: Continuity of Terrestrial and Aquatic Habitat Networks

Countywide Planning Policy Rationale

"Adjacent jurisdictions shall identify and protect habitat networks that are aligned at jurisdictional boundaries. Networks shall link large protected or significant blocks of habitat within and between jurisdictions to achieve a continuous Countywide network. These networks shall be mapped and displayed in comprehensive plans." (CA-7) "All jurisdictions shall identify critical fish and wildlife habitats and species and develop regulations that a) promote their protection and proper management; and b) integrate native plant communities and wildlife with other land uses where possible." (CA-8) "Natural drainage systems including associated riparian and shoreline habitat shall be maintained and enhanced to protect water quality, reduce public costs, protect fish and wildlife habitat, and prevent environmental degradation." (CA-9)

Background

This year Indicator 17 focuses on the quality of terrestrial and aquatic habitat, rather than its continuity. The continuity of wildlife habitat remains an important measure, and will be addressed in future reports.

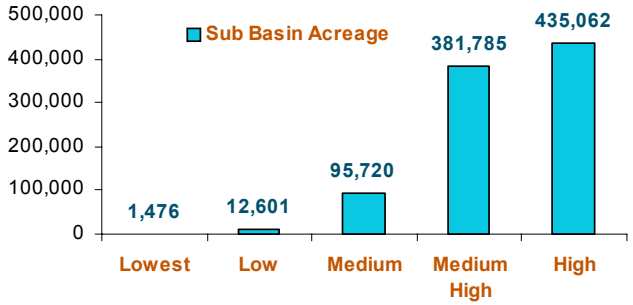
The relative environmental quality of all sub-basins in rural King County (between the urban growth and forest production boundaries) and urban King County was evaluated using three sets of environmental data that were available countywide. The three sets of data combined direct biological usage information (salmonid usage) with two measures of landscape condition, road density and percent of vegetative (forest) cover. Each of the sub-basins was ranked on a three point (high, medium or low) numeric scale for each of the three conditions. The numerical rankings were then summed to give a composite score for each sub-basin. The composite scores were then divided into five equal intervals to determine the number of sub-basins and acres within rural and urban zoned lands that were of lowest, low, medium, medium high and high environmental quality.

The validity of basing the composite score on these three conditions was supported by recent studies by M. Alberti (U.W., in press) These studies demonstrated a high correlation between the biological integrity of small streams in King County, as measured by the benthic index of biotic integrity, and both percent of vegetative cover and road density in the drainage basin.

Key Trends

- Habitat quality, along with water quality and quantity, provide the core building blocks for a healthy, functioning ecosystem, and for achieving long-term environmental results such as salmonid or other species recovery.
- Habitat quality as indicated by road density and forest cover is dramatically better in rural sub-basins than in urban sub-basins. In rural sub-basins, 88% of the total acreage is in the medium-high or high quality quintiles.

Fig. 17.1 **Rural Sub Basin Acreage by Quality of Habitat**



- Only 3% of acreage in the urban sub-basins is in the medium-high category. None is in the highest category.

Fig. 17.2 **Urban Sub Basin Acreage by Quality of Habitat**

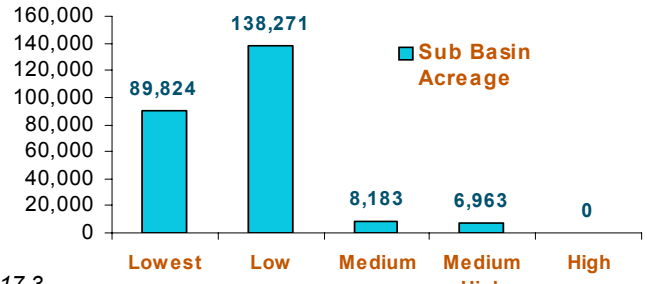
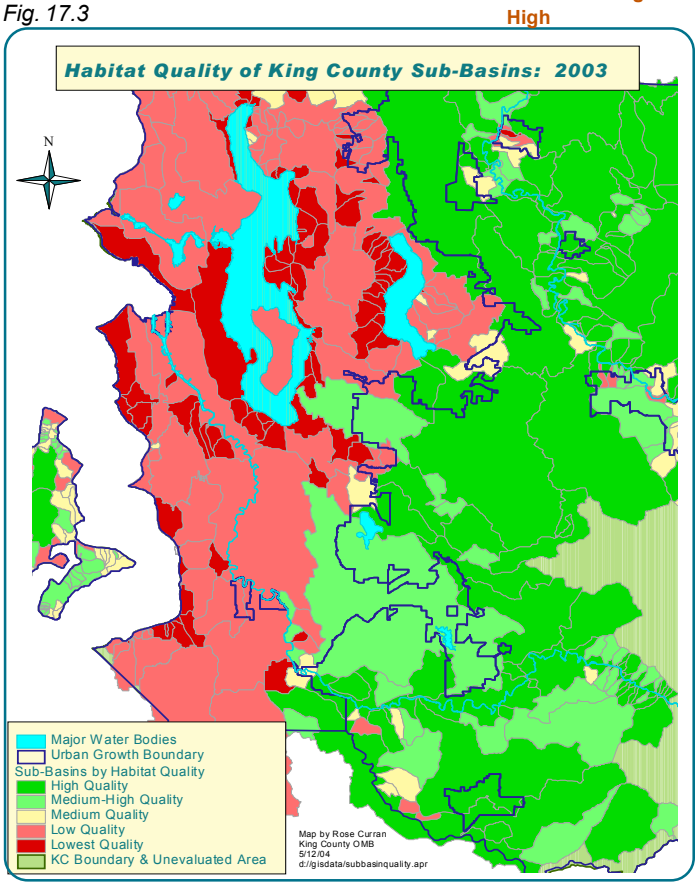


Fig. 17.3



(Continued on page 17)

Indicator 17 (continued)

What We Are Doing

- Working in partnership with all jurisdictions in King County to develop and implement Salmon Conservation Plans which will recommend actions to both protect and prevent further harm to salmonid habitats throughout the sub-basins in King County.
- Making specific recommendations for landscape, riparian and in-stream habitat protection and restoration including capital improvement projects, stewardship, incentive and volunteer options, and regulatory options.
- Adopting new Critical Area Ordinance (CAO) standards by December 2004 that will include regulatory standards and best management practices that protect and restore vegetative cover and encourage practices that protect and/or restore salmonid habitat.

Outcome: Increase Salmon Stock

Indicator 18: Change in the Number of Salmon

Countywide Planning Policy Rationale

"All jurisdictions shall identify critical fish and wildlife habitats and species and develop regulations that a) promote their protection and proper management; and b) integrate native plant communities and wildlife with other land uses where possible." (CA-8) "Natural drainage systems including associated riparian and shoreline habitat shall be maintained and enhanced to protect water quality, reduce public costs, protect fish and wildlife habitat, and prevent environmental degradation. Jurisdictions within shared basins shall coordinate regulations to manage basins and natural drainage systems which include provisions to: a) protect the natural hydraulic and ecological functions of drainage systems, maintain and enhance fish and wildlife habitat, and restore and maintain those natural functions; b) control peak runoff rate and quantity of discharges from new development to approximate pre-development rates; and c) preserve and protect resources and beneficial functions and values through maintenance of stable channels, adequatel low flows, and reduction of future storm flows, erosion, and sedimentation." (CA-9) "...Jurisdictions shall coordinate land use planning and management of fish and wildlife resources with affected state agencies and the federally-recognized Tribes." (CA-11)

Background

Salmon in Puget Sound have diverse life histories and rely upon different habitats at various points in their life history for spawning, rearing, feeding,and migrating. They can be an important source of information about the health of those habitats. The abundance, geographic distribution, genetic diversity and productivity of salmon can be indicative of the overall health of both their marine and freshwater ecosystems. This indicator focuses only on information related to changes in the quantity of salmon returning to spawn in the freshwater lakes and streams of King County.

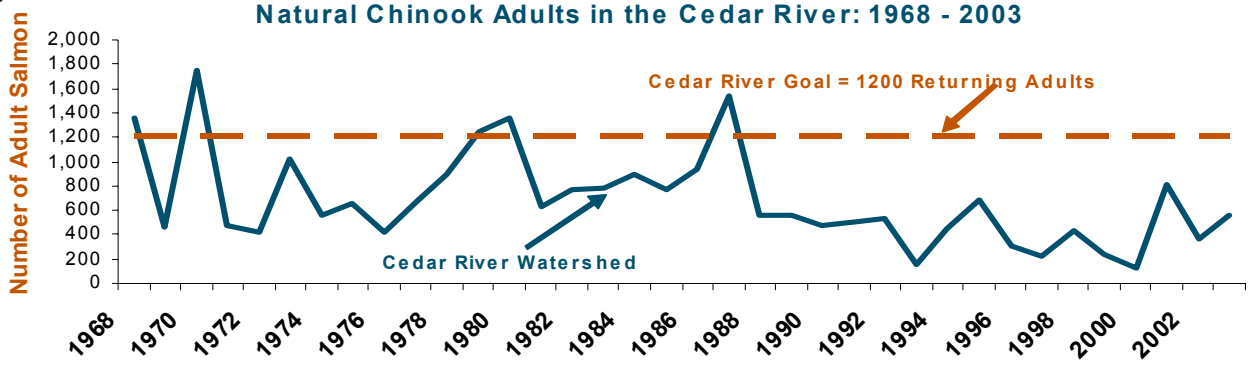
*For salmon and steelhead stocks, the term **escapement** refers to those mature fish that have survived all fisheries, have returned to freshwater, and constitute the spawning population for a given stock. All data presented in the graphs are adult salmon escapement data. The term **natural fish** refers to those fish that spawn naturally whether or not they originated in a hatchery or in the wild.*

The Lake Washington System is comprised of the Cedar River and its tributaries; Lake Washington and its northern tributaries, the Sammamish River and Lake Sammamish and their tributaries (including Issaquah Creek). See Indicator #13 above for a map of King County watersheds. The Green River Watershed includes the Duwamish River and the Green River and its tributaries. The Snoqualmie-Snohomish Watershed includes the Skykomish, Snoqualmie, and Snohomish basins and their tributaries. Over one-half of this watershed lies in King County.

Key Trends

- Native, natural-spawning salmon have undergone a precipitous decline in Puget Sound watersheds, and in other west coast watersheds, over the last century. For some stocks there has been a reduction to barely 10% of their historic numbers of returning adult fish.
- Much of the variation in salmon returns is due to natural variability unrelated to human influences. However, the decline in natural-spawning Chinook, Coho, and Sockeye stocks is considerably more enduring than would be expected from natural fluctuations. Habitat degradation (both freshwater and marine), barriers to fish migration, and harvesting are among the human factors.
- The gravity of this decline has been confirmed by the listing of Chinook salmon and bull trout under the Endangered Species Act.

Fig. 18.1

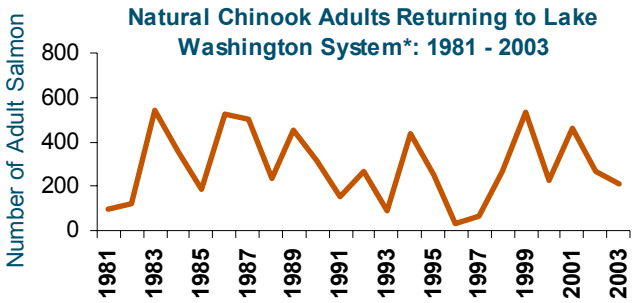


Indicator 18 (continued)

Chinook

- Fig. 18.1 shows the level of returning adult Chinook in the Cedar River watershed over the last 35 years. While there are major fluctuations from year to year, the average runs over the last decade are about one half of what they were as recently as the 1970s and 1980s.
- Chinook in the Lake Washington's northern tributaries (Fig. 18.2) were already quite low in the 1980s when recent monitoring efforts began. Less than 100 salmon returned to this basin in 1993, 1996, and 1997. The average count for the past decade is about 18% lower than in the 1980s.

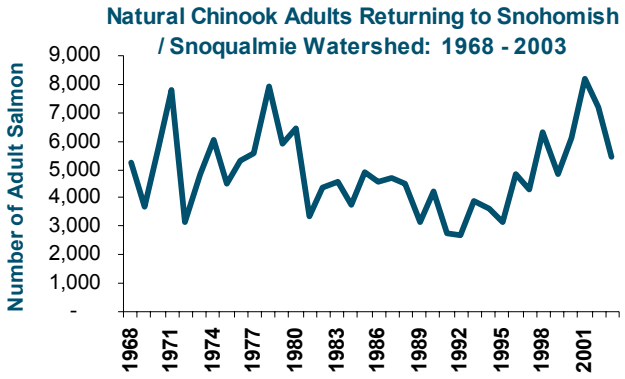
Fig. 18.2



*This represents the north tributaries to Lake Washington, distinct from the Cedar River Watershed.

- While the level of Chinook returns in the Snohomish/Snoqualmie watershed was particularly low in the 1980's to early 1990s, the numbers have rebounded, and are now consistent with the levels of the 1960's and 70's. This watershed runs through mostly rural areas with minimal freshwater habitat degradation.

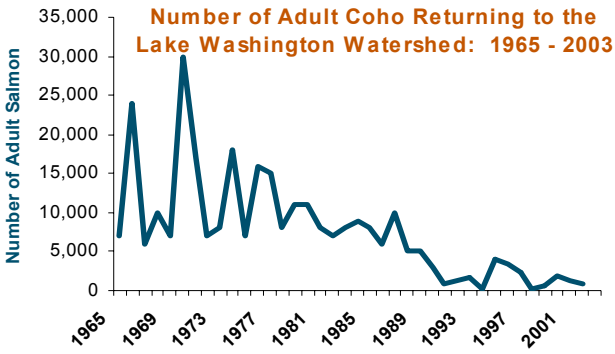
Fig. 18.3



Coho

- Since 1995, the annual adult returns of Coho in the Lake Washington watershed have averaged under 2,000. From 1965 - 1985 the average adult return was over 10,000. It fell to around 4,000 during the 1985 to 1995 period.

Fig. 18.4



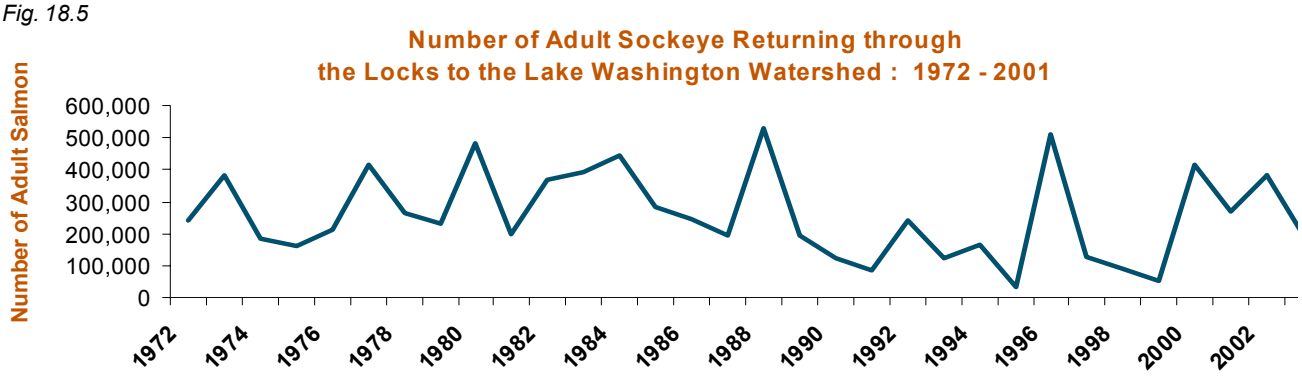
Sockeye

- The average annual return of Sockeye through the locks to the Lake Washington and Cedar River basins (Fig. 18.5) dipped somewhat during the 1990 - 1999 period, but recently has returned to the averages experienced during 1970 - 1990.

What We Are Doing

- Controlling fisheries at the national and international level. Marine conditions and fisheries have the greatest impact on trends in the survival of adult salmon. Canadian fisheries, which intercepted 30 - 60% of Puget Sound Coho have declined to almost zero impact since 1995, due to conservation demands for Canadian Chinook and Coho stocks.
- Aggressively reducing U.S. fisheries as well, in response to the ESA listings of Chinook. Control of fisheries, coupled with improved marine conditions have led to much higher adult return level in many of the stocks in the last few years. However, this does not necessarily mean improvement in freshwater spawning conditions or production of young fish.
- Instituting broader stream buffers and limiting new development, particularly in the rural areas where habitat conditions are still relatively high quality and can be conserved.
- In urban and suburban areas, where natural salmon production continues to be constrained by poor freshwater habitat, working to restore and enhance habitat if it is feasible.

Fig. 18.5



Indicator 18 (continued)

- Providing flood and run-off control to prevent further degradation in habitat.
- Reducing juvenile salmon mortality due to predators at the Ballard Locks.
- Working to maintain the distinction between natural-spawning (wild) and hatchery fish, and to strengthen measures to protect habitat needed by natural salmon. The number of natural adult returns are complicated by hatchery salmon straying to natural spawning grounds, or intermingling with naturally-spawned salmon. Record high adult returns do not necessarily mean improved natural spawning production.

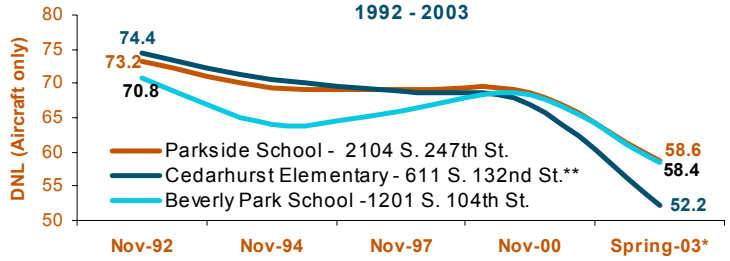
Outcome: Decrease Noise Levels

Indicator 19: Change in Noise from Vehicles, Planes, and Yard Equipment

Countywide Planning Policy Rationale

Although the Countywide Planning Policies do not contain specific policy direction for noise, the Benchmark Task Force added this Indicator because there were concerns about noise levels in King County. The Task Force also wanted to monitor how growth management issues affected noise levels.

Average Sound Levels (DNL) at SeaTac Monitoring Stations: 1992 - 2003



*Noise data for the 3rd and 4th quarters of 2003 is not yet available. **The monitoring station w as changed in 1999, but the new site is close to the old.

Background

Day-Night Average Sound Level (DNL) is a noise measure used to describe the average noise exposure levels over a 24-hour period. It is based on an A-weighted (dBA) sound level scale, which represents a sound generally as the human ear hears it, while excluding sound outside the human range.

The Federal Aviation Administration (FAA) certifies aircraft by noise levels. The noiser Stage 1 and 2 aircraft have been phased out of operation, and only the quieter Stage 3 aircraft operate today.

Key Trends

- Since 1992 there has been dramatic improvement in the average sound levels recorded at SeaTac International Airport community monitoring sites.
- While the noise levels in 1992 were in the 71 - 74 DNL range, they have fallen to the 52 - 58 DNL range in 2003. This is mainly due to the completion of the phasing out of noisier Stage I and Stage II aircraft, as required by the FAA.
- Generally, a DNL of 65 or greater is considered significant noise exposure, while a DNL of 75 or greater is considered severe noise exposure.

Outcome: Decrease Waste Disposal and Increase Recycling

Indicator 20: Pounds of waste disposed and recycled per capita

Countywide Planning Policy Rationale

Although the Countywide Planning Policies do not include policy direction for reducing solid waste or promoting recycling programs, the Benchmark Task Force added this Indicator, because recycling and reductions in solid waste save resources and landfill space, and reduce the potential for soil and water contamination due to leakage from landfills.

Background

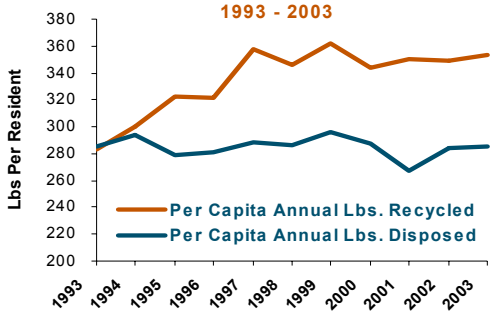
King County Solid Waste Department monitors waste disposal and recycling for all of King County outside of Seattle, while Seattle monitors its own waste disposal and recycling. In King County residential recycling includes mainly single family curbside recycling including yard waste. In Seattle the apartment recycling program is included in the residential recycling numbers. Residential yard waste is also included. Data on commercial waste disposed is available from Seattle. King County hopes to collect data on apartment and commercial disposal and recycling beginning in 2004.

Key Trends

- In 1993, King County households disposed and recycled about equal amounts of waste. As Fig. 20.1 shows, by 2003, approximately 25% more waste per capita was being recycled by households in the County, while per capita waste disposed remained about the same.
- The total amount of waste generated per person (both recycled and disposed) has risen 12.5% during that period. It is somewhat compensated by for increased recycling. However, the countywide goal is to decrease waste disposal as well as to increase recycling.
- There is a notable downward trend in total commercial waste per employee in Seattle, from over 1,141 lbs per employee in 1990 to 906 lbs per employee in 2002.

Fig. 20.1

Pounds of Residential Waste Per Capita Recycled or Disposed in King County (including Seattle): 1993 - 2003



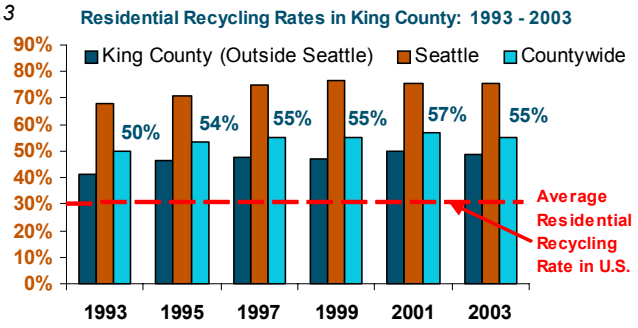
Indicator 18 (continued)

- Commercial waste in Seattle varies with the economic cycles. The per employee figure compensates for changes in employment level, and shows a healthy decrease in commercial waste generation.

Fig. 20.2

- Both Seattle and King County outside Seattle have had very good success with their curbside residential recycling programs.
- Fig. 20.3 shows that King County now recycles 55% of its residential waste, while the U.S. average for residential recycling is about 30%. In 2003, Seattle recycled 75% of its household waste, while King County outside Seattle recycled about 49%.

Fig. 20.3



What We Are Doing

- In King County, initiating programs to improve food waste collection for households and commercial users, and increase materials that can be recycled.
- Working to reduce disposal of commercial paper.
- Improving data collection for multi-family and non-residential reycling.

Same Benchmarks, New Format

The King County Benchmark Program is in its eighth year of publishing an annual report on progress in meeting the Countywide Planning goals. This year it comes to its readers in an experimental format, which is currently being evaluated. It consists of five issues, of which this is the fifth. The Land Use Indicators were published in August, the Economic Development Indicators were published in October, the Affordable Housing Indicators in December, and the Transportation Indicators in March. All published Benchmark Reports are available on the web at www.metrokc.gov/budget/benchmrk .

Data Sources

Indicator 9: Percent of Land Developed

Data Sources: King County Department of Natural Resource (DNRP), KC GIS Center; LandSat Images of Impervious Surface and Forest Cover Change provided by Marshall and Associates, Inc. and King County GIS.

Indicator 10: Air Quality

Data Source: Puget Sound Air Clean Air Agency The agency's website www.pscleanair.org has in-depth information on the region's air quality. It also includes links to the Washington State Dept. of Ecology and the U.S. EPA websites. Air Quality initiatives supplied by KC DNRP Air Quality Analyst. Global climate data from report of the Intergovernmental Panel on Climate Chante (IPCC), 2001, and the Hadley Center for Climate Prediction and Research (www.met-office.gov.uk/research) "Our Warming World" Seattle P.I., June 2003.

Indicator 11: Energy Consumption

Data Sources: Seattle City Light; Puget Sound Energy (formerly Puget Power); Washington Natural Gas; Washington State Departments of Transportation and of Energy; Energy Information Administration (EIA). U.S. Department of Energy; Statistical Abstract 2003 for worldwide energy consumption. New York Times, "Fuel Economy Hit 22 Year Low in 2002" (5/3/04) and "Average U.S. Car is Tipping Scales at 4,000 Pounds" (5/5/04)

Indicator 12: Vehicle Miles Traveled

Data Source: Highway Performance Monitoring Reports 1981-2003, Washington State Department of Transportation. Vehicle Miles Traveled (VMT) per Year is based on approximate total miles traveled in King County. HPMS is not designed for use at the local jurisdictional level, but rather foruse in determining the needs for roadways at the State level. When aggregated at the county level, the figures may overstate the increase in VMT. VMT is a general measure of travel demand that is used for both air quality management and transportation demand management.

Indicator 13: Surface Water Quality

Data Source: King County Department of Natural Resources, Water and Land Resources Division.

Indicator 14: Water Consumption

Data Source: Seattle Public Utilities (SPU), 2003. SPU supplies water, primarily from the Tolt and Cedar River watersheds, to about 76% of King County residents and to residents of Edmonds and Olympic View. This includes water that is sold wholesale to hundreds of smaller water purveyors that serve outlying areas of the County. Water District 83, Redmond, and Highline are within the SPU service area, but have other sources of supply. Water from other sources amounts to about 7 million gallons per day which are not included in Fig. 14.1 or 14.2.

Indicator 15: Groundwater Quality and Quantity

Data Sources: King County Department of Natural Resources and Parks, Water and Land Resources Division. For more information about the King County Groundwater Protection Program Call 206-263-6159

Indicator 16: Change in Wetland Acreage and Function

Data Sources: King County DNRP. LandSat Images and Analysis of Change in Wetlands from 1992 - 2001 provided by Marshall and Associates, Inc. and King County GIS Center. Best available countywide data on existing wetlands (c. 1990 - 1994) provided by National Wetlands Inventory and KC GIS.

Indicator 17: Continuity of Terrestrial and Aquatic Habitat.

Data Sources: King County Department of Natural Resources and Parks, Water and Land Resources Division. Proposed Critical Areas Ordinances, KC DDES.

Indicator 18: Increase Salmon Stock

Data Sources: Washington Department of Fisheries, Washington Department of Wildlife, and Western Washington Treaty Indian Tribes. Initiatives undertaken: KC DNRP and KC DDES (Proposed Critical Areas Ordinances).

Indicator 19: Change in Noise Levels.

Data Sources: Sea-Tac Airport Noise Monitoring system.

Indicator 20: Waste Disposed and Recycled

Data Sources: King County DNRP: Solid Waste Division, Finance and Administration Section. Seattle Public Utilities, Resource Planning Division, Forecasting and Evaluation Section.